5   What is claimed is:

6   1. A method for quickly and reliably transmitting a byte stream from a sending node

7   having a number of credits with an established connection to a receiving node in a

8   communication environment having a plurality of nodes and a plurality of

9   interconnectable paths, the method comprising:

10   transmitting a predetermined number of bytes of a byte stream from a sending node

11   to a receiving node, said predetermined number of bytes corresponding to the

12   number of credits present at said sending node;

13   transmitting a predetermined number of credits from said receiving node to said

14   sending node when a predetermined event occurs; and

15   transmitting a predetermined number of negative acknowledgements from said

16   receiving node to said sending node, when at least one transmitted byte is lost or

17   corrupted.

1   2. The method of claim 1, further including the step of retransmitting at least once, from

2   said sending node to said receiving node, said lost or corrupted bytes corresponding to

3   said predetermined number of negative acknowledgments received at said sending

4   node.

1   3. The method of claim 1, wherein said step of transmitting said predetermined number

2   of credits from said receiving node to said sending node occurs before the transmission

3   of said predetermined number of bytes of said byte stream.

1   4. The method of claim 3, wherein said step of transmitting of said predetermined

2   number of credits occurs during a connection establishment of said sending node and

3   said receiving node.

1   5. The method of claim 3, wherein said step of transmitting of said predetermined

2   number of credits occurs after a connection establishment of said sending node and said

3   receiving node.

1   6. The method of claim 1, wherein said predetermined event is one from the group of a)

2   a predetermined number of bytes from said byte stream is received at said receiving

3   node, b) a predetermined number of bytes from said byte stream is received at said

4   receiving node and a congestion indicator at said receiver node is less than a

5   predetermined threshold, c) a predetermined number of bytes from said byte stream is

6   received at said receiving node and a data error indicator at said receiver node is less

7   than a predetermined threshold, d) a buffer at said receiving node, containing said bytes

8   transmitted from said sending node to said receiving node, has free space, e) a buffer at

9   said receiving node, containing said bytes transmitted from said sending node to said

10   receiving node, has free space and a congestion indicator at said receiver node is less

11   than a predetermined threshold, and f) a buffer at said receiving node, containing said

12   bytes transmitted from said sending node to said receiving node, has free space and a

13   data error indicator at said receiver node is less than a predetermined threshold.

1   7. The method of claim 1, wherein the reception of said credits at said receiving node

2   indicates that at least a subset of said byte stream was correctly received at said

3   receiving node.

1   8. The method of claim 1, wherein said step of transmitting of said predetermined

2   number of credits is dependent upon a counter exceeding a predetermined number

3   representative of received bytes at said receiving node, said transmitting step including

4   the steps of:

5   transmitting a predetermined number of credits from said receiving node to said

6   sending node when said counter is equal to at least a predetermined value; and

7   decrementing said counter by said byte size upon transmission of said credits.

1   9. The method of claim 1, wherein said credits from said credit transmission step are

2   reduced or delayed to reflect congestion detection in an established connection.

1 10. The method of claim 1, wherein said step of transmitting of said predetermined
2 number of bytes is dependent upon a counter exceeding a predetermined number
3 representative of received credits at said sending node, said transmitting step including
4 the steps of:
5   transmitting said bytes from said sending node to said receiving node when said
6   counter is equal to at least said number of bytes; and
7   decrementing said counter by said number of bytes upon said transmission of said
8   bytes.

1 11. The method of claim 1, wherein said bytes transmitted in said byte transmission
2 step are in the form of Transmission Control Protocol (TCP) packets, whereby said
3 method is compatible at the application programming level of TCP.

1 12. The method of claim 1, wherein the established connection between said sending
2 node and said receiving node is established using the standard 3-way handshake of
3 Transmission Control Protocol (TCP).

1 13. The method of claim 1, further including the step of resetting said established
2 connection when said transmission of at least one of said negative acknowledgements
3 occurs a predetermined number of times.

1 14. The method of claim 1, wherein said transmitting of said predetermined number of
2 credits occurs by piggybacking existing traffic with said credits from said receiving
3 node to said sending node.

1 15. The method of claim 1, wherein said credits in said credit transmission step are not
2 retransmitted if they are lost.

1 16. The method of claim 1, wherein said predetermined number of negative
2 acknowledgements is transmitted at predetermined events.

1 17. The method of claim 1, wherein said at least one corrupted byte is detected by
2 means of error detection hardware only.

1   18. The method of claim 1, wherein said at least one corrupted byte is detected only

2   once by software error detection means.

1   19. A method for quickly and reliably transmitting a byte stream from a sending node

2   having credits with an established connection to a receiving node in a communication

3   environment having a plurality of nodes and with a plurality of interconnectable paths,

4   where the bytes of said byte stream are formed into a plurality of data packets of a

5   protocol, the method comprising:

6   providing a predetermined identifier associated with data packets;

7   if said predetermined identifier indicates a credit and negative acknowledgement

8   transport system, transmitting a predetermined number of bytes of a byte stream

9   from a sending node to a receiving node, corresponding to the number of credits

10   present at said sending node;

11   transmitting a predetermined number of credits from said receiving node to said

12   sending node when a predetermined even occurs; and

13   transmitting a predetermined number of negative acknowledgements from said

14   receiving node to said sending node, when at least one transmitted byte is lost or

15   corrupted.

1   20. The method of claim 19, the step further comprising:

2   if said predetermined identifier indicates a transport system that is not exclusively

3   credit and   negative acknowledgement based, processing

4   said data stream by a transport system independent of credit and negative

5   acknowledgements, whereby compatibility at the application programming level of

6   a protocol is maintained.

1   21. The method of claim 19, the steps further comprising:

2   providing a first packet filter for filtering data packets at a sending node;

3   providing a second packet filter for filtering data packets at a receiving node, so

4   that said predetermined identifier indicates a credit and negative acknowledgement

5   transport system dependent on said first and second packet filters.

1　22. The method of claim 19, further including the step of retransmitting at least once,
2　from said sending node to said receiving node, said lost or corrupted bytes
3　corresponding to said predetermined number of negative acknowledgments received at
4　said sending node.

1　23. The method of claim 19, wherein said step of transmitting said predetermined
2　number of credits from said receiving node to said sending node occurs before the
3　transmission of said predetermined number of bytes of said byte stream.

1　24. The method of claim 23, wherein said step of transmitting of said predetermined
2　number of credits occurs during a connection establishment of said sending node and
3　said receiving node.

1　25. The method of claim 23, wherein said step of transmitting of said predetermined
2　number of credits occurs after a connection establishment of said sending node and said
3　receiving node.

1　26. The method of claim 19, wherein said predetermined event is one from the group of
2　a) a predetermined number of bytes from said byte stream is received at said receiving
3　node, b) a predetermined number of bytes from said byte stream is received at said
4　receiving node and a congestion indicator at said receiver node is less than a
5　predetermined threshold, c) a predetermined number of bytes from said byte stream is
6　received at said receiving node and a data error indicator at said receiver node is less
7　than a predetermined threshold, d) a buffer at said receiving node, containing said bytes
8　transmitted from said sending node to said receiving node, has free space, e) a buffer at
9　said receiving node, containing said bytes transmitted from said sending node to said
10　receiving node, has free space and a congestion indicator at said receiver node is less
11　than a predetermined threshold, and f) a buffer at said receiving node, containing said
12　bytes transmitted from said sending node to said receiving node, has free space and a
13　data error indicator at said receiver node is less than a predetermined threshold.

1　27. The method of claim 19, wherein the reception of said credits at said receiving node
2　indicates that at least a subset of said byte stream was correctly received at said
3　receiving node.

1 28. The method of claim 19, wherein said step of transmitting of said predetermined
2 number of credits is dependent upon a counter exceeding a predetermined number
3 representative of received bytes at said receiving node, said transmitting step including
4 the steps of:
5   transmitting a predetermined number of credits from said receiving node to said
6   sending node when said counter is equal to at least a predetermined value; and
7   decrementing said counter by said byte size upon transmission of said credits.

1 29. The method of claim 19, wherein said credits from said credit transmission step are
2 reduced or delayed to reflect congestion detection in an established connection.

1 30. The method of claim 19, wherein said step of transmitting of said predetermined
2 number of bytes is dependent upon a counter exceeding a predetermined number
3 representative of received credits at said sending node, said transmitting step including
4 the steps of:
5   transmitting said bytes from said sending node to said receiving node when said
6   counter is equal to at least said number of bytes; and
7   decrementing said counter by said number of bytes upon said transmission of said
8   bytes.

1 31. The method of claim 19, wherein said bytes transmitted in said byte transmission
2 step are in the form of Transmission Control Protocol (TCP) packets, whereby said
3 method is compatible at the application programming level of TCP.

1 32. The method of claim 19, wherein the established connection between said sending
2 node and said receiving node is established using the standard 3-way handshake of
3 Transmission Control Protocol (TCP).

1 33. The method of claim 19, further including the step of resetting said established
2 connection when said transmission of at least one of said negative acknowledgements
3 occurs a predetermined number of times.

1 34. The method of claim 19, wherein said transmitting of said predetermined number of
2 credits occurs by piggybacking existing traffic with said credits from said receiving
3 node to said sending node.

1   35. The method of claim 19, wherein said credits in said credit transmission step are not

2   retransmitted if they are lost.

1   36. The method of claim 19, wherein said predetermined number of negative

2   acknowledgements is transmitted at predetermined events.

1   37. The method of claim 19, wherein said at least one corrupted byte is detected by

2   means of error detection hardware only.

1   38. The method of claim 19, wherein said at least one corrupted byte is detected only

2   once by software error detection means.

1   39. A system for quickly and reliably transmitting a byte stream from a sending node

2   having credits with an established connection to a receiving node in a communication

3   environment having a plurality of nodes with a plurality of interconnectable paths,

4   comprising:

5   means for transmitting a predetermined number of bytes of a byte stream from a

6   sending node to a receiving node, said predetermined number of bytes

7   corresponding to the number of credits present at said sending node;

8   means for transmitting a predetermined number of credits from said receiving node

9   to said sending node when a predetermined event occurs; and

10   means transmitting a predetermined number of negative acknowledgements from

11   said receiving node to said sending node, when at least one transmitted byte is lost

12   or corrupted.

1   40. The system of claim 39, further comprising:

2   means for retransmitting at least once, from said sending node to said receiving

3   node, said lost or corrupted bytes corresponding to said predetermined number of

4   negative acknowledgments received at said sending node.

1   41. The system of claim 39, further comprising:

2   means for transmitting said predetermined number of credits from said receiving

3   node to said sending node occurs before the transmission of said predetermined

4   number of bytes of said byte stream.

1 42. The system of claim 41, wherein said means for transmitting of said predetermined
2 number of credits occurs during a connection establishment of said sending node and
3 said receiving node.

1 43. The system of claim 41, wherein said means for transmitting of said predetermined
2 number of credits occurs after a connection establishment of said sending node and said
3 receiving node.

1 44. The system of claim 39, wherein said predetermined event is one from the group of
2 a) a predetermined number of bytes from said byte stream is received at said receiving
3 node, b) a predetermined number of bytes from said byte stream is received at said
4 receiving node and a congestion indicator at said receiver node is less than a
5 predetermined threshold, c) a predetermined number of bytes from said byte stream is
6 received at said receiving node and a data error indicator at said receiver node is less
7 than a predetermined threshold, d) a buffer at said receiving node, containing said bytes
8 transmitted from said sending node to said receiving node, has free space, e) a buffer at
9 said receiving node, containing said bytes transmitted from said sending node to said
10 receiving node, has free space and a congestion indicator at said receiver node is less
11 than a predetermined threshold, and f) a buffer at said receiving node, containing said
12 bytes transmitted from said sending node to said receiving node, has free space and a
13 data error indicator at said receiver node is less than a predetermined threshold.

1 45. The system of claim 39, wherein the reception of said credits at said receiving node
2 indicates that at least a subset of said byte stream was correctly received at said
3 receiving node.

1 46. The system of claim 39, wherein said means for transmitting of said predetermined
2 number of credits is dependent upon a counter exceeding a predetermined number
3 representative of received bytes at said receiving node, said transmitting means
4 comprising:
5   means for transmitting a predetermined number of credits from said receiving node
6   to said sending node when said counter is equal to at least a predetermined value;
7   and
8   means for decrementing said counter by said byte size upon transmission of said
9   credits.

1   47. The system of claim 39, wherein said credits from said means for credit

2   transmission are reduced or delayed to reflect congestion detection in an established

3   connection.

1   48. The system of claim 39, wherein said means for transmitting of said predetermined

2   number of bytes is dependent upon a counter exceeding a predetermined number

3   representative of received credits at said sending node, said transmitting means

4   comprising:

5   means for transmitting said bytes from said sending node to said receiving node

6   when said counter is equal to at least said number of bytes; and

7   means for decrementing said counter by said number of bytes upon said

8   transmission of said bytes.

1   49. The system of claim 39, wherein said bytes transmitted by said byte transmission

2   means are in the form of Transmission Control Protocol (TCP) packets, whereby said

3   system is compatible at the application programming level of TCP.

1   50. The system of claim 39, wherein the established connection between said sending

2   node and said receiving node is established using the standard 3-way handshake of

3   Transmission Control Protocol (TCP).

1   51. The system of claim 39, further comprising:

2   means for resetting said established connection when said transmission of at least

3   one of said negative acknowledgements occurs a predetermined number of times.

1   52. The system of claim 39, wherein said means for transmitting of said predetermined

2   number of credits occurs by piggybacking existing traffic with said credits from said

3   receiving node to said sending node.

1   53. The system of claim 39, wherein said credits in said credit transmission means are

2   not retransmitted if they are lost.

1   54. The system of claim 39, wherein said predetermined number of negative

2   acknowledgements is transmitted at predetermined events.

1   55. The system of claim 39, wherein said at least one corrupted byte is detected by

2   means of error detection hardware only.

1   56. The system of claim 39, wherein said at least one corrupted byte is detected only

2   once by software error detection means.

1   57. A system for quickly and reliably transmitting a byte stream from a sending node

2   having credits with an established connection to a receiving node in a communication

3   environment having a plurality of nodes and with a plurality of interconnectable paths,

4   where the bytes of said byte stream are formed into a plurality of data packets of a

5   protocol, the system comprising:

6   a predetermined identifier associated with data packets;

7   means for transmitting a predetermined number of bytes of a byte stream from a

8   sending node to a receiving node, corresponding to the number of credits present at

9   said sending node, if said predetermined identifier indicates a credit and negative

10   acknowledgement transport system;

11   means for transmitting a predetermined number of credits from said receiving node

12   to said sending node when a predetermined even occurs; and

13   means for transmitting a predetermined number of negative acknowledgements

14   from said receiving node to said sending node, when at least one transmitted byte is

15   lost or corrupted.

1   58. The system of claim 57, further comprising:

2   means for processing said data stream by a transport system independent of credit

3   and negative acknowledgements, if said predetermined identifier indicates a

4   transport system that is not exclusively credit and negative acknowledgement

5   based, whereby compatibility at the application programming level of a protocol is

6   maintained.

1   59. The system of claim 57, further comprising:

2   a first packet filter for filtering data packets at a sending node;

3   a second packet filter for filtering data packets at a receiving node, so that said

4   predetermined identifier indicates a credit and negative acknowledgement transport

5   system dependent on said first and second packet filters.

1   60. The system of claim 57, further comprising:

2   means for retransmitting at least once, from said sending node to said receiving

3   node, said lost or corrupted bytes corresponding to said predetermined number of

4   negative acknowledgments received at said sending node.

1   61. The system of claim 57, further comprising:

2   means for transmitting said predetermined number of credits from said receiving

3   node to said sending node occurs before the transmission of said predetermined

4   number of bytes of said byte stream.

1   62. The system of claim 61, wherein said means for transmitting of said predetermined

2   number of credits occurs during a connection establishment of said sending node and

3   said receiving node.

1   63. The system of claim 61, wherein said means for transmitting of said predetermined

2   number of credits occurs after a connection establishment of said sending node and said

3   receiving node.

1   64. The system of claim 57, wherein said predetermined event is one from the group of

2   a) a predetermined number of bytes from said byte stream is received at said receiving

3   node, b) a predetermined number of bytes from said byte stream is received at said

4   receiving node and a congestion indicator at said receiver node is less than a

5   predetermined threshold, c) a predetermined number of bytes from said byte stream is

6   received at said receiving node and a data error indicator at said receiver node is less

7   than a predetermined threshold, d) a buffer at said receiving node, containing said bytes

8   transmitted from said sending node to said receiving node, has free space, e) a buffer at

9   said receiving node, containing said bytes transmitted from said sending node to said

10   receiving node, has free space and a congestion indicator at said receiver node is less

11   than a predetermined threshold, and f) a buffer at said receiving node, containing said

12   bytes transmitted from said sending node to said receiving node, has free space and a

13   data error indicator at said receiver node is less than a predetermined threshold.

1   65. The system of claim 57, wherein the reception of said credits at said receiving node

2   indicates that at least a subset of said byte stream was correctly received at said

3   receiving node.

1   66. The system of claim 57, wherein said means for transmitting of said predetermined

2   number of credits is dependent upon a counter exceeding a predetermined number

3   representative of received bytes at said receiving node, said transmitting means

4   comprising:

5   means for transmitting a predetermined number of credits from said receiving node

6   to said sending node when said counter is equal to at least a predetermined value;

7   and

8   means for decrementing said counter by said byte size upon transmission of said

9   credits.

1   67. The system of claim 57, wherein said credits from said means for credit

2   transmission are reduced or delayed to reflect congestion detection in an established

3   connection.

1

2   68. The system of claim 57, wherein said means for transmitting of said predetermined

3   number of bytes is dependent upon a counter exceeding a predetermined number

4   representative of received credits at said sending node, said transmitting means

5   comprising:

6   means for transmitting said bytes from said sending node to said receiving node

7   when said counter is equal to at least said number of bytes; and

8   means for decrementing said counter by said number of bytes upon said

9   transmission of said bytes.

1   69. The system of claim 57, wherein said bytes transmitted by said byte transmission

2   means are in the form of Transmission Control Protocol (TCP) packets, whereby said

3   system is compatible at the application programming level of TCP.

1   70. The system of claim 57, wherein the established connection between said sending

2   node and said receiving node is established using the standard 3-way handshake of

3   Transmission Control Protocol (TCP).

1   71. The system of claim 57, further comprising:

2   means for resetting said established connection when said transmission of at least

3   one of said negative acknowledgements occurs a predetermined number of times.

1   72. The system of claim 57, wherein said means for transmitting of said predetermined

2   number of credits occurs by piggybacking existing traffic with said credits from said

3   receiving node to said sending node.

1   73. The system of claim 57, wherein said credits in said credit transmission means are

2   not retransmitted if they are lost.

1   74. The system of claim 57, wherein said predetermined number of negative

2   acknowledgements is transmitted at predetermined events.

1   75. The system of claim 57, wherein said at least one corrupted byte is detected by

2   means of error detection hardware only.

1   76. The system of claim 57, wherein said at least one corrupted byte is detected only

2   once by software error detection means.